Contractor Coordination Meeting
Fuel Cells for Transportation Program,
Washington DC, October 30, 2001

Title of Project: Development of High-Performance, Low-Pt Cathodes

Contractor: Superior MicroPowders

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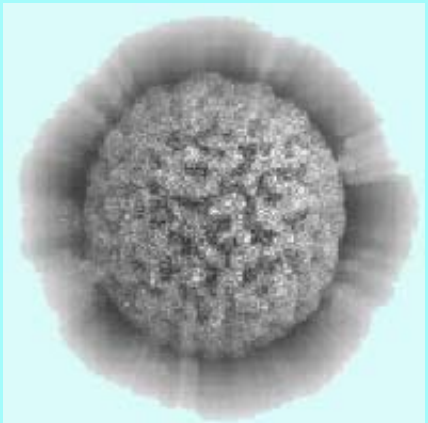

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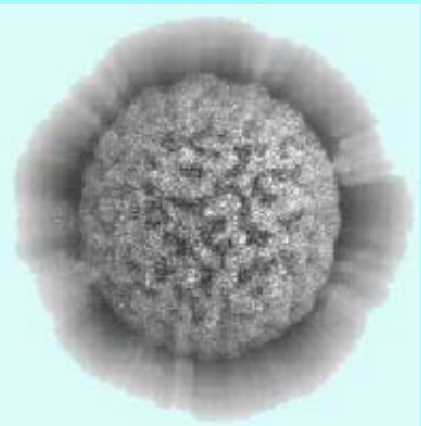
Development of High-Performance, Low-Pt Cathodes

Subcontractors:

Combinatorial Discovery Company
Computational Fluid Dynamics RC (CFDRC)

Stack Testing in Kind:

Automotive Fuel Cell Manufacturers



Principal Investigator:

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Development of High-Performance, Low-Pt Cathodes

Project Duration:

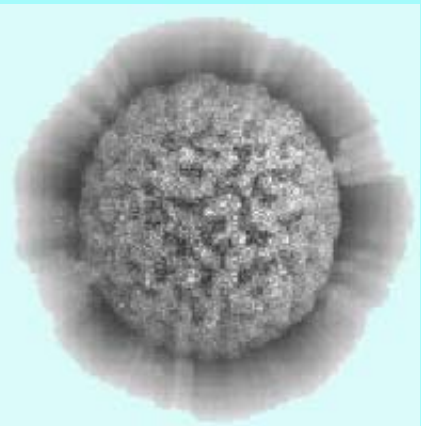
Start Date: September 1st, 2001

Duration: 43 months

End Date: March 31st, 2005

Funding:

Total Contract Value: $3,625,000



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Development of High-Performance, Low-Pt Cathodes

- ***The Problem:***
  - Large amount of Pt used in electrodes
  - High price of Pt and high volatility of the PM
  - High fabrication cost of electrode components
- ***The Need:***
  - High-volume, low-cost production of high-performance reproducible low-Pt electrocatalyst powders
- ***The Solution Platform:***
  - SMP's revolutionary spray-based process for manufacturing of electrocatalyst powders

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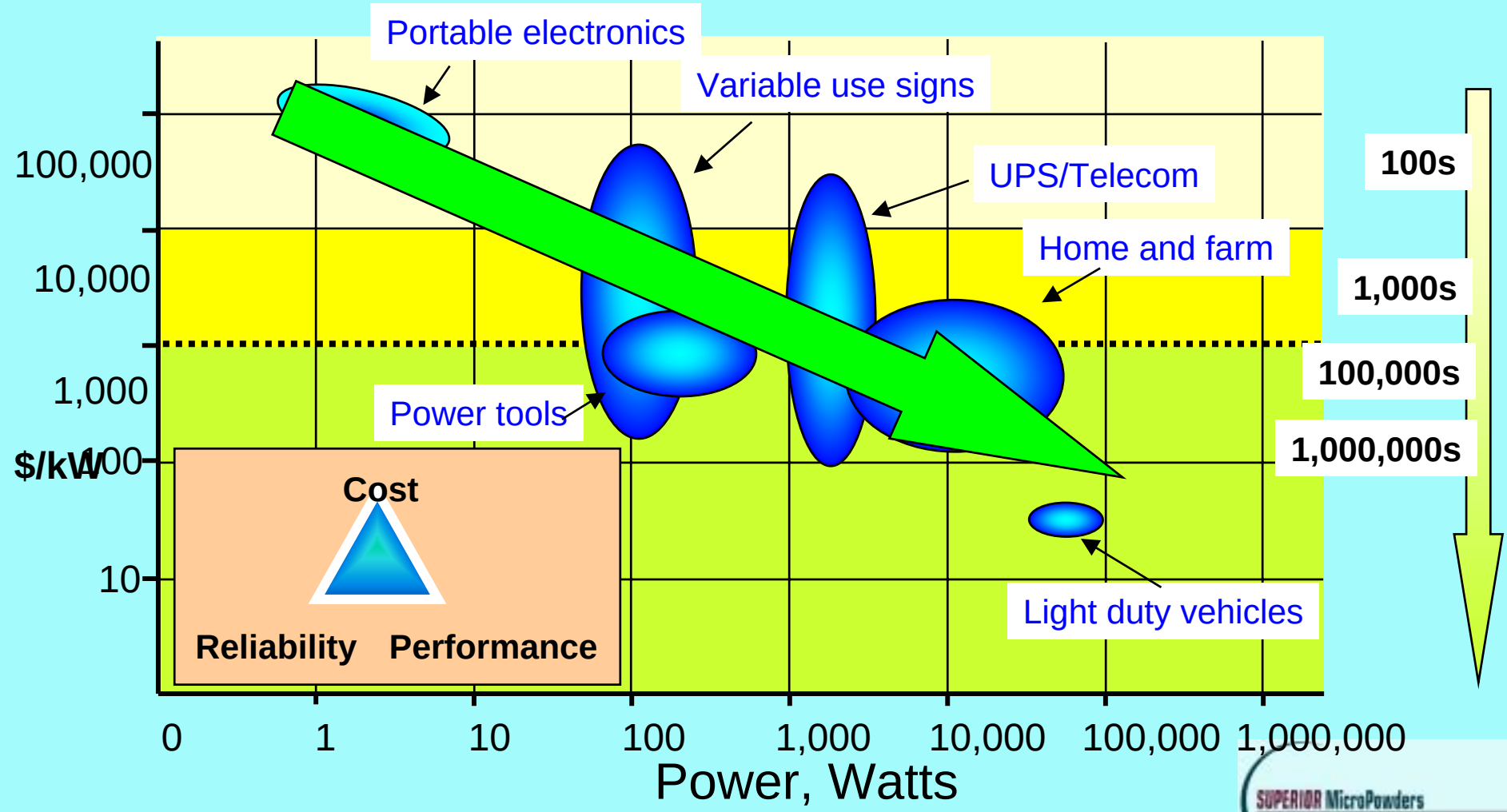
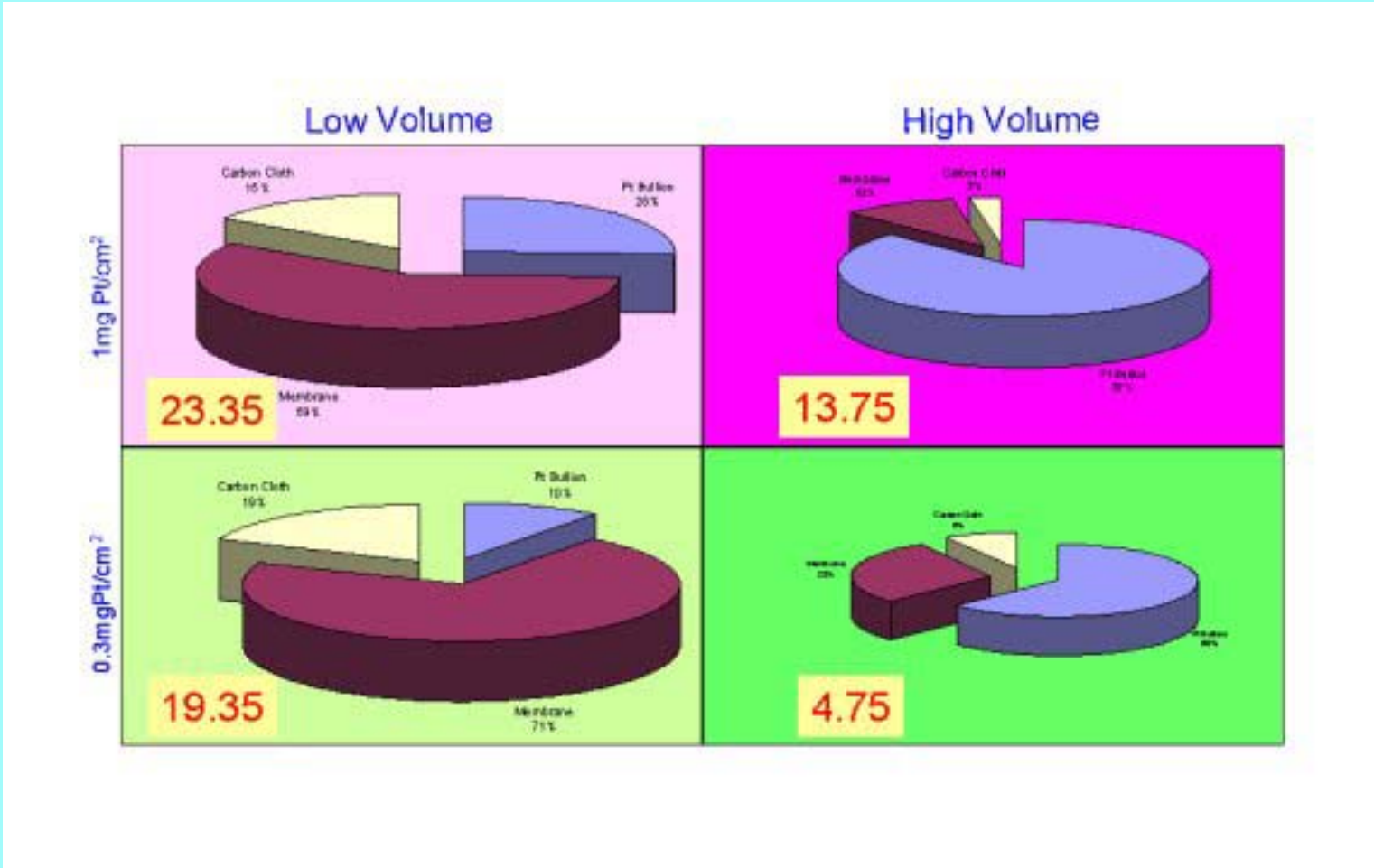
The Problem:
Market Entry Barrier: Cost to Consumer

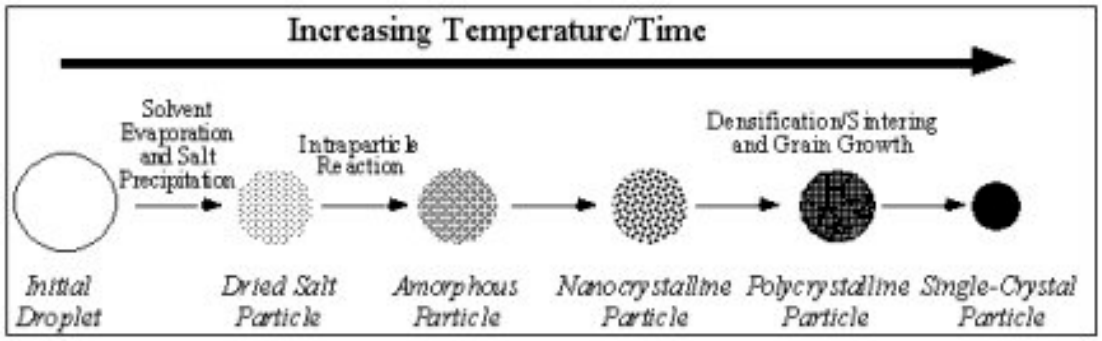


The Problem:

Market Entry Barrier: Component Costs



The Solution Platform:
SMP's Spray Based EC Manufacturing



- Simple, robust, reliable process
  - Highly controllable, single step processing
  - Highly reproducible
  - "Green" methodology with minimal waste streams
- Not material specific
  - Inorganics, organics, metals, metal oxides
- Ability to highly engineer critical properties
  - Particle morphologies
  - Particle size distributions
  - Bulk chemistries and structures
  - Surface chemistries and structures
  - Complicated compositions

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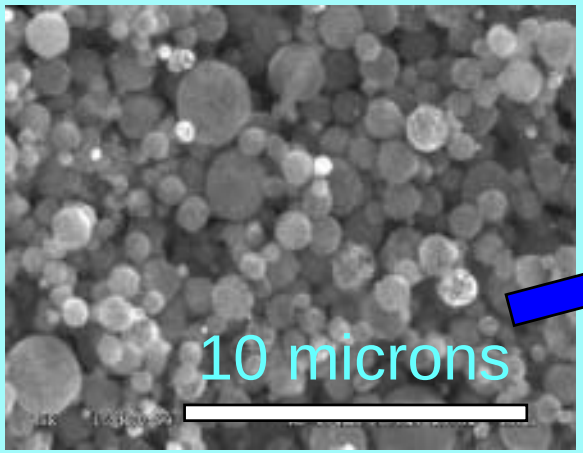
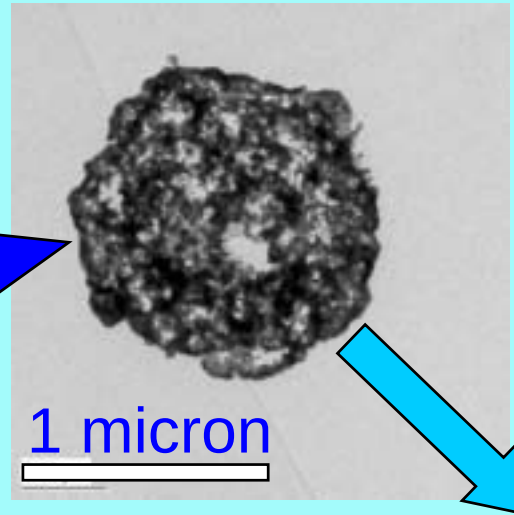
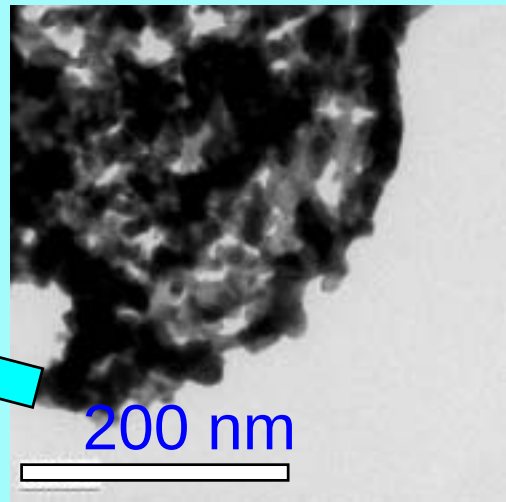
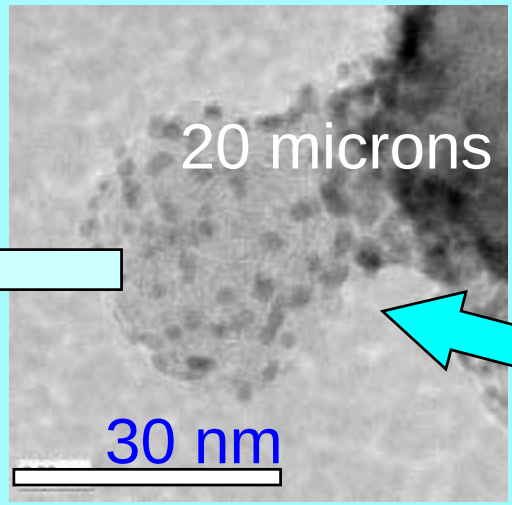
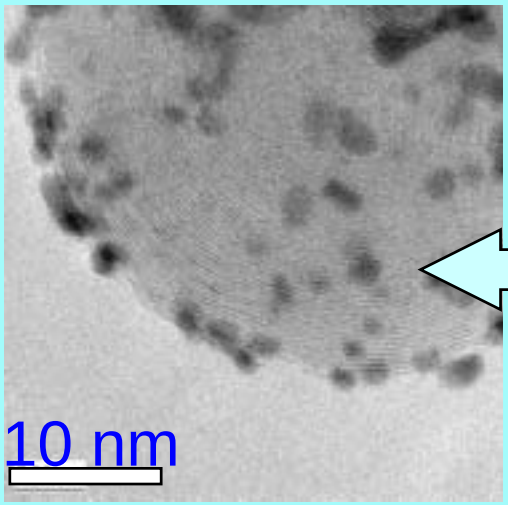
Hierarchical Structure of SMP Electrocatalyst



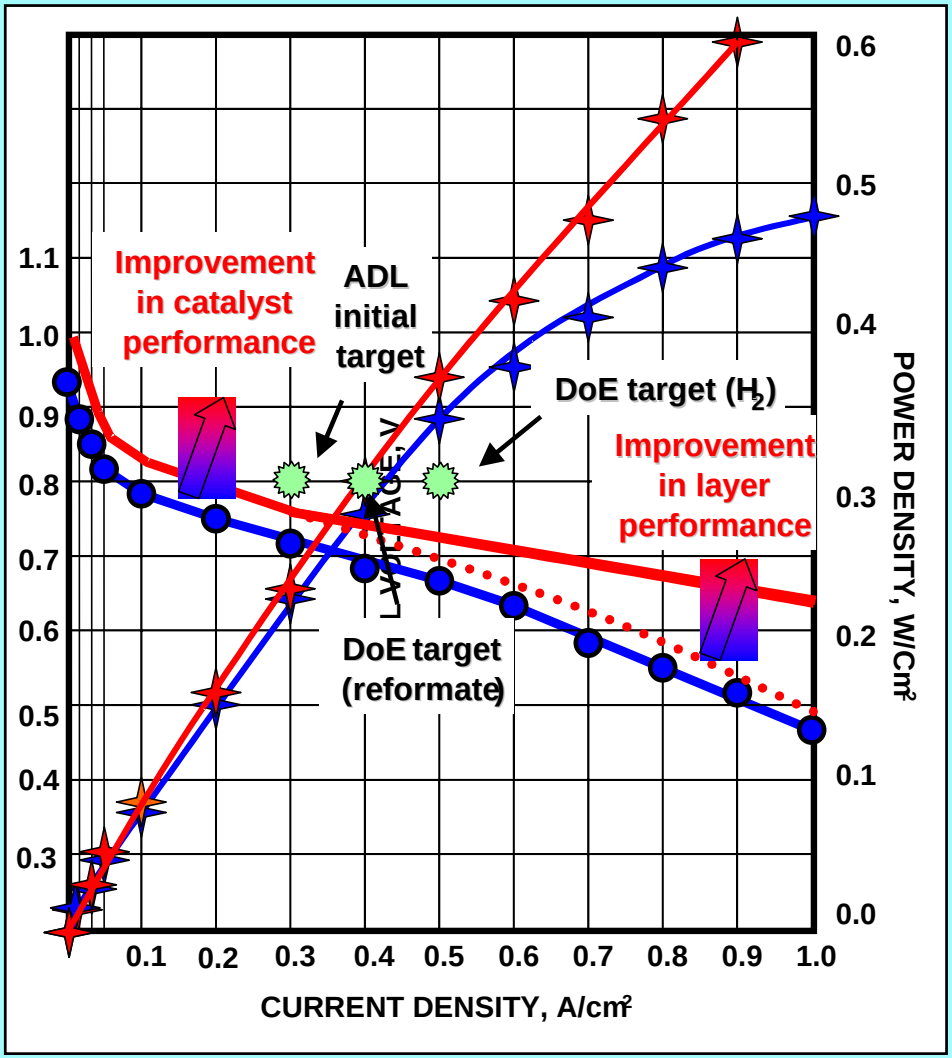








Technical Goals and Objectives



- DOE target performance:
  - 1 gPt/kW at 0.8 V pressurized gases

0.05 mg Pt/cm² cathode loading

- SMP current performance: (atm. pressure):

0.2 mg Pt/cm² cathode loading

  - 3.3 gPt/kW at 0.8V
  - 1.1 gPt/kW at 0.7 V
  - 0.6 gPt/kW at 0.6 V

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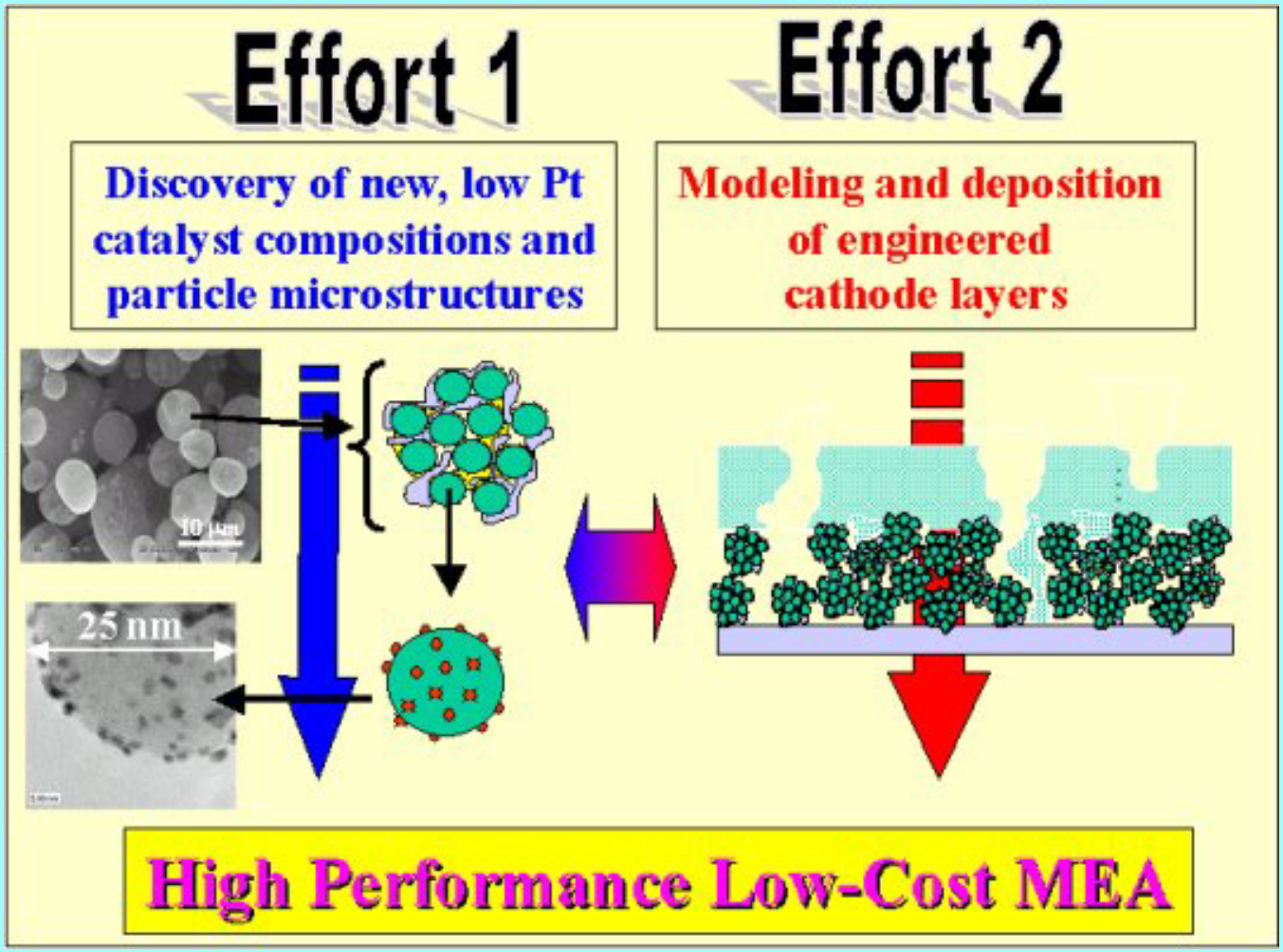
Technical Concept



- *Effort 1:*
  - *SMP*
  - *CC*
- *Effort 2:*
  - *SMP/*
  - *CFDRC*
- *Short Stack Testing*

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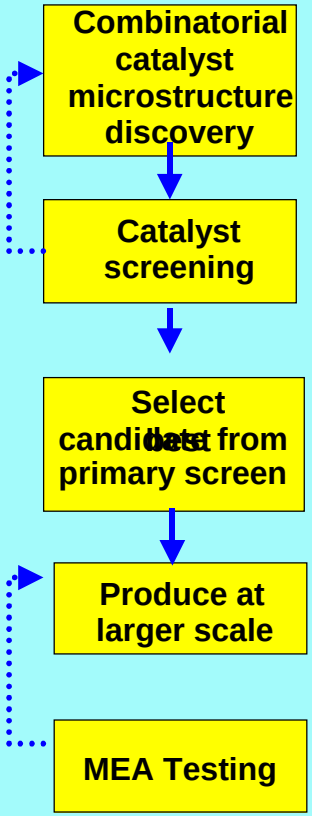
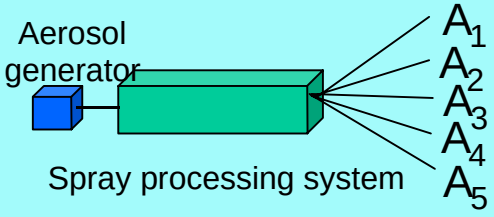
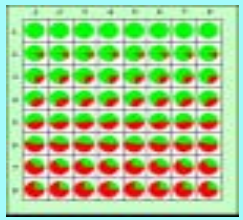
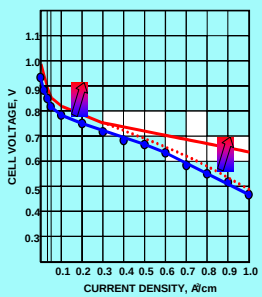
Work Plan Effort 1: Combinatorial Approach









- ***Combinatorial Powder Synthesis System (CPSS)***
  - Synthesis of Binary Alloys and Mixed Metal/Metal Oxides
  - Synthesis of Ternary Alloys
- ***Rapid Catalyst Screening for ORR Activity***

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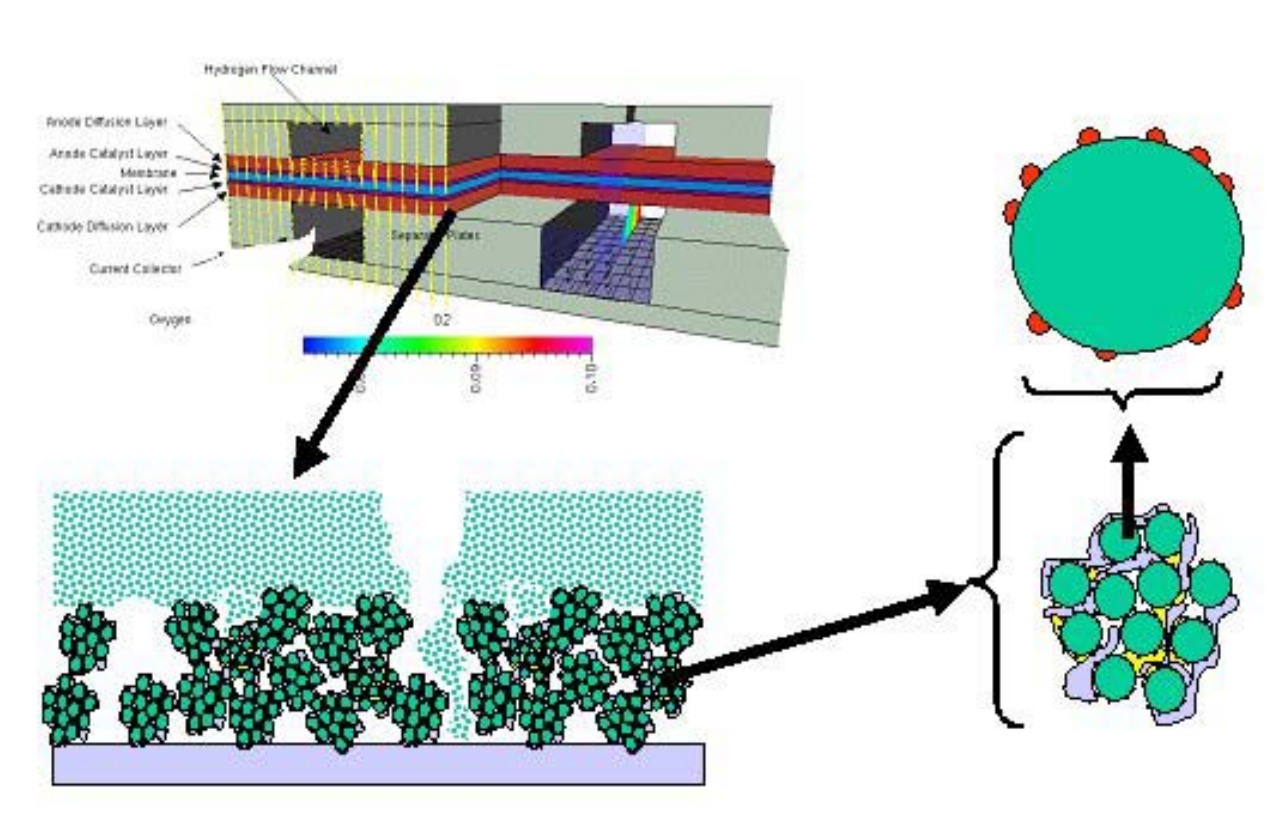
Work Plan Effort 2: Engineered Cathode Structures



- ***Fuel Cell and Cathode Modeling (CFDRC)***
- ***Engineered Cathode Structures (SMP)***
  - ***Composite particles***
  - ***Novel cathode structures***
- ***Testing in small scale (50 cm^2) MEA (SMP)***

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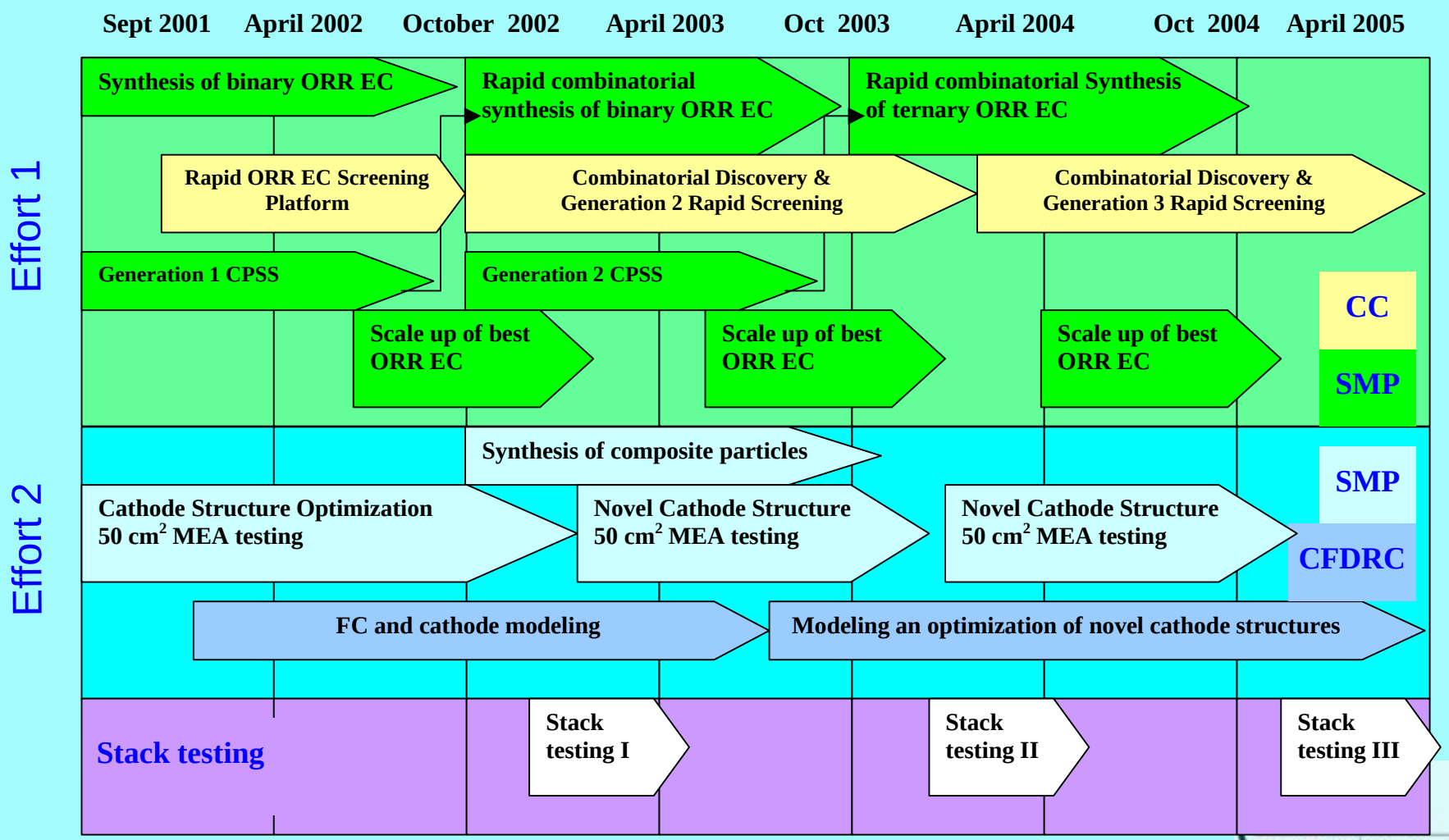
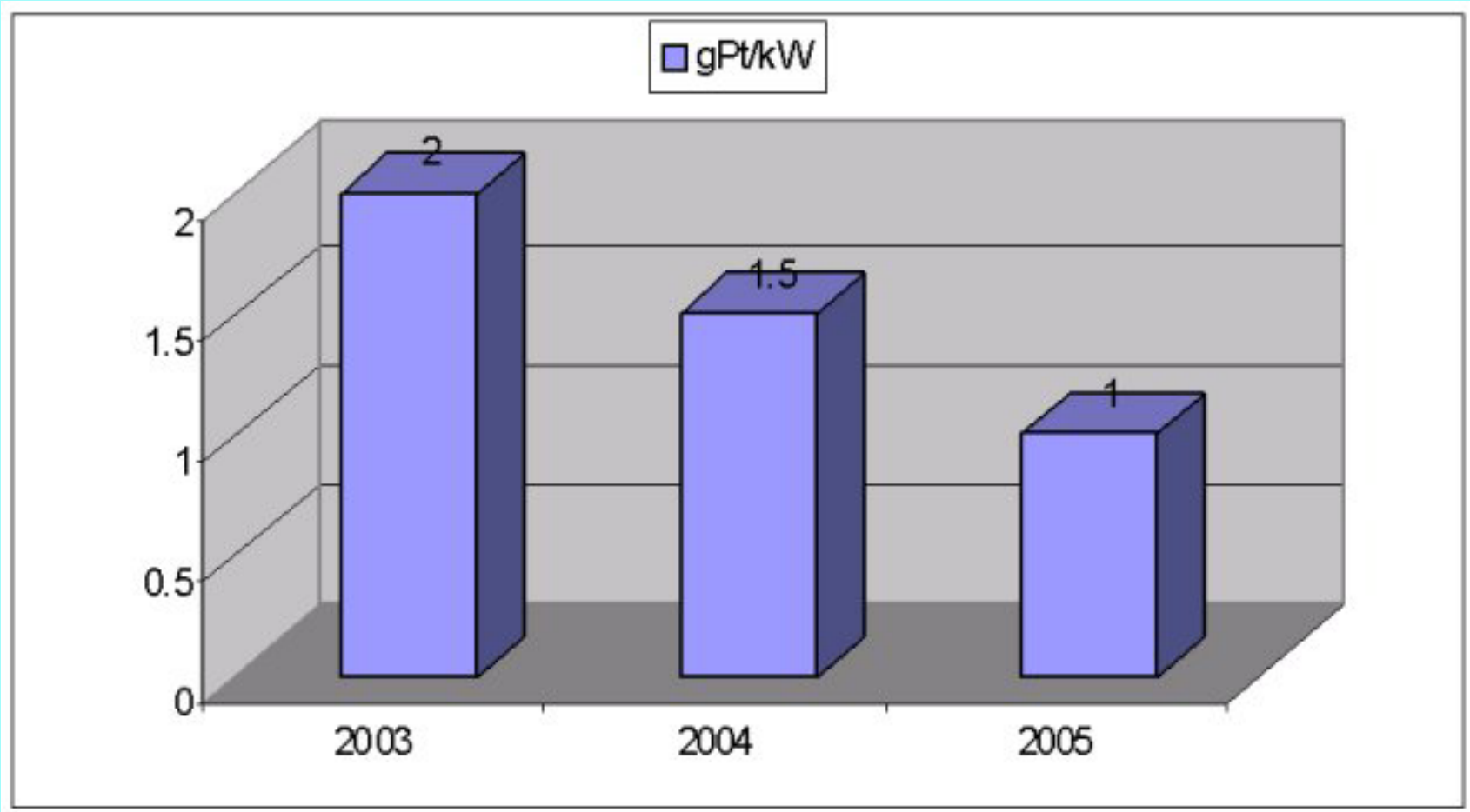
Project Schedule & Milestones



Performance Targets and Milestones



Success of the Project

- *Meet or exceed the DOE Targets for performance at low Pt loading in automotive fuel cell stack test.*
- *Demonstrate ability to manufacture materials and structures developed in this program at high volume and low cost.*

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Collaboration/Cooperation

- Collaboration with DOE funded National Lab projects for fundamental studies
- Cooperation with other DOE funded projects:
  - Improved or novel membranes
  - Improved or novel GDL
  - Improved components and FC designs
  - Novel catalyst compositions

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